

Table 4. Summary of studies that found genetically-based phenotypic differences between hatchery (or farmed) and naturally produced salmonids.

Author; Species tested	Locally derived hatchery stock?	Number of generations removed from wild stock	Age/stage tested	Hybrids tested?	Findings
Berejikian (1995); Steelhead	Yes	4 to 7	Age-0	No	Progeny of wild fish survived predation from sculpin better than size-matched progeny of hatchery fish in both laboratory studies and in natural stream enclosures
Berejikian et al., (1996); Steelhead	Yes	4 to 7	Age-0	No	Progeny of wild fish were more aggressive than progeny of hatchery fish at emergence. However, progeny of hatchery fish were more aggressive than progeny of wild fish after 3 months rearing in a natural stream channel, or rearing in hatchery tanks at low density and low ration.
Einum & Fleming (1997); Atlantic salmon	No	7	Age-0	Yes	In hatchery environment, farmed fish more aggressive than fish from wild fish (Imsa) population. Farmed fish were more prone to predation risk than both wild populations (Imsa and Lone) and had higher growth rates than both wild populations. Hybrid (Farmed x Wild) dominated both farmed and wild fish (Lone) in pairwise contests. In the wild, farmed and hybrid fish had higher growth rates than wild fish.
Fleming & Einum (1997); Atlantic salmon	Yes	7	Age-0	No	Farmed fish had more robust body shape and smaller rayed fins than wild fish. Farmed fish were more aggressive than wild fish in the hatchery environment. Wild fish were more aggressive than farmed fish in the stream environment. Farmed fish were more risk prone than wild fish. Farmed fish had higher growth rates than wild fish. Competition with wild fish in semi-natural environment negatively affected growth of farmed fish.

Author; Species tested	Locally derived hatchery stock?	Number of generations removed from wild stock	Age/stage tested	Hybrids tested?	Findings
Johnsson et al., (1996); Brown trout [anadromous]	Yes	8	Age-0	No	Hatchery fish had higher growth rate and food conversion efficiency than wild fish. Hatchery fish & wild fish showed no differences in dominance index, or level of aggressiveness. Wild fish had stronger antipredator response than hatchery fish .
Johnsson et al., (2001); Atlantic salmon	Yes	7	Age-1+ & Age-2+	No	Age-1+ wild fish had significantly higher standard heart rates, and pronounced flight and heart rate response to simulated avian predator attack than age-1+ farmed fish. Age-2+ wild fish had lower standard heart rate than age-2+ farmed fish. Response to predator in Age-2+ fish was considerably weaker (environment x genetic interaction).
Johnsson & Abrahams (1991); Steelhead	No (adults pooled from 2 distinct wild populations)	Domesticated rainbow trout >5 generations	Age-0	Yes	Hybrid (Hatchery x Wild) fish exhibited significantly greater willingness to risk exposure to a predator than wild fish. Hybrids and wild fish had equal susceptibility to predation. Therefore, hybrids had higher probability of being eaten by the predator
Petersson & Järvi (2000); Brown trout	Yes	8	Age-1	No	Hatchery fish had higher growth rate (weight gain and RNA/DNA ratio) than wild fish. There was no difference in aggressive behavior (MIS) between hatchery fish and wild fish.
Reinhardt et al., (2001); Masu salmon	*	*	Age-0	No	Farmed fish had higher survival and growth rates than wild fish when reared in stream enclosure both in the presence and absence of predators. In the absence of an initial size advantage, farmed fish were superior competitors than wild fish.

Author; Species tested	Locally derived hatchery stock?	Number of generations removed from wild stock	Age/stage tested	Hybrids tested?	Findings
Reinhardt (2001); Masu salmon	Unknown	Sea-ranched: 18 to 22 Farmed: 5 to 8	Age-0	No	Wild fish held positions lower in the water column than hatchery fish or farmed fish both before and during feeding. Hatchery fish, wild fish, & farmed fish held higher average positions in the water column over the course of the experiment (time effect). There were no differences in agonistic behavior between hatchery fish, wild fish, & farmed fish.
Reisenbichler & Rubin (1977); Steelhead	Yes	≤ 2	Eyed embryo to age-1	Yes	In stream environments, wild fish had significantly higher survival than hybrids (Hatchery x Wild) or hatchery fish, but hybrids had significantly higher growth rates than hatchery fish or wild fish. In the hatchery environment, hatchery fish had the highest survival and growth rates.
Swain & Riddell (1990); Coho salmon	No	Both hatchery populations were 5 generations removed	Age-0	No	Juveniles from both hatchery fish populations were more aggressive in mirror image stimulation tests than juveniles from the regionally matched wild fish. Also the level of aggressive behavior differed regionally between hatchery fish & wild fish populations.

Table 4. Summary and conclusions.

1. Hatchery and farmed fish tend to exhibit reduced fright responses and/or are at greater risk of predation than wild fish in 5 of 5 studies.
2. Hatchery and farmed fish more aggressive than wild fish in 3 studies, less aggressive than wild in 2 studies, and no difference in 3 studies. Effects seem to differ depending on the environment tested (i.e., laboratory, stream, hatchery).
3. Hatchery/farmed fish exhibit higher growth rates than wild in 6 out of 6 studies (in stream and hatchery environments).
4. Hybrids evaluated in only 3 studies. Reisenbichler and Rubin, Johnsson and Abrahams, and Einum and Fleming. Hybrids usually intermediate in terms of competition and growth, but Einum and Fleming found hybrids to grow faster than farmed or wild.